Urea cycle

The ureosynthetic cycle (urea, ornithine) is used to break down nitrogen from the body with the help of hydrophilic urea*. Urea is then excreted together with the urine out of the body and the body is thus rid of toxic ammonia.*

Urea cycle in general

The urea cycle takes place only in the **liver**, where ammonia reacts with other cycle components. The product is urea, which travels through the bloodstream to the kidneys, where it is excreted in the aqueous environment. At the cellular level, two stages are distinguished in the cycle – in mitochondria and in the cytosol.

The source of ammonia is mainly ``amino acids**, partially metabolism of purines and pyrimidines, synthesis of hemeu or colon bacteria.**

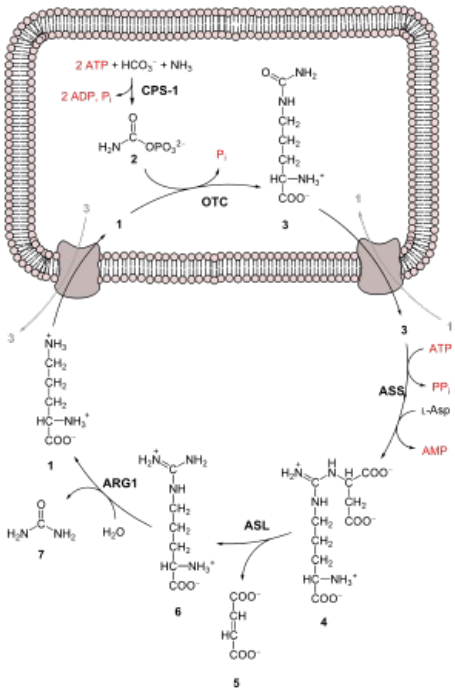
The elimination of toxic ammonia is absolutely essential for the survival of the individual. NH_3 molecules are toxic to the body and even a small concentration can be fatal. The **brain** is most sensitive to the concentration of ammonia in the blood. Nitrogen is therefore transported embedded in amino acids (glutamate) or in the non-toxic protonated form NH_4^+. The form in which ammonia is found also depends on pH.

Urea cycle disorders are accompanied by neurological symptoms ranging from mild to mental retardation, impaired consciousness, and death.

Individual reactions

The urea cycle consists of these reactions[1]:

1. **Ammonia entry into the ornithine cycle**:
   - $NH_3 + CO_2 + 2ATP \rightarrow$ carbamoyl phosphate + Pi + 2ADP
   - catalyzed by the enzyme **carbamoylphosphate synthase'', *which requires the presence of*** *Mg^{2+}* ***and*** *N-acetylglutamate* for its activity
   - takes place in the **mitochondria matrix'**
2. **Carbamoyl phosphate reaction with ornithine**:
   - carbamoyl phosphate + ornithine → citrulline + Pi
   - catalyzed by **L-ornithine-carbamoyltransferase'**
   - takes place in the **mitochondria matrix'**
3. **Citrulline and aspartate reaction**
   - citrulline + ATP + aspartate → argininosuccinate + AMP + PPi
   - catalyzes **arginine succinate synthetase'**
   - takes place in **cytosol**
4. **Argininosuccinate cleavage**
   - argininosuccinate Template:Reverse reaction arginine + fumarate
   - catalyzes **argininsuccinase'**
   - takes place in **cytosol**
   - *fumarate may participate in the citrate cycle*
5. **Urea formation**
   - arginine → ornithine + urea
   - catalyzes **argininase'**
   - takes place in **cytosol**
   - urea passes into the blood, ornithine returns to the mitochondrial matrix



Scheme of reactions: **1** - ornithine, **2** - carbamoyl phosphate, **3** - citrulline, **4** - argininosuccinate, **5** - fumarate, **6** - arginine, **7** - urea, **L-Asp ' – *L-aspartate,*** *CPS-1* **– *carbamoyl phosphate synthetase,*** *OTC* **– *ornithine carbamoyltransferase,*** *ASS* **– *arginine succinate synthetase,*** *ASL* **– *arginine succinase,*** **'ARG1** – arginase

Regulation of the urea cycle

The cycle is regulated by:

- the activity of *carbamoyl phosphate synthase* is under the influence of the allosteric effector *N-acetylglutamate*
- concentration of **ornithine'** in mitochondria for the first step of the cycle
- increased or decreased '*degradation of amino acids*

Links

Related Articles

- ws:Močovinový cyklus
- Urea cycle disorders
- Amino Acids
- Urea

References

1. MURRAY, Robert K. *Harper's Biochemistry.* 2. edition. Jinocany : H&H, 2002. 313 pp. ISBN 80-7319-013-3.

References

- KIDNEY, Miroslav, et al. *Biochemistry for medical students. Part I.* 2. edition. Prague : Karolinum, 2009. 269 pp. pp. 226-228. ISBN 978-80-246-1416-8.
- MURRAY, Robert K. *Harper's Biochemistry.* 2. edition. Jinocany : H&H, 2002. pp. 312-315. ISBN 80-7319-013-3.